

AUTOMATIC DETECTION OF HUMAN PARASITE WORM USING  
MICROSCOPIC IMAGE

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This thesis is submitted as partial fulfillment of the requirements for the award of the  
Bachelor of Electrical Engineering (Electronics)

Faculty of Electrical & Electronics Engineering  
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MAY, 2012

## **ABSTRACT**

This project investigates about the development of automatic detection of egg of human parasites using microscopic images. The MATLAB software is the tool to analyse the image processing technique applied in this research. The stages of image processing technique are image acquisition, processing, classification and testing. The input image is a microscopic image with three different resolutions. The experiment parasites are found in faecal samples provided by doctor at HUSM. This project had been categorized the two types of parasites worm which is Roundworm, *Ascaris Lumbricoides* and Whipworm, *Trichuris Trichiura*. The identification of the parasites is based on its eggs roundness, shape and smoothness characteristics. The MATLAB software recognized the types of parasite based on classification that had been done before. The image processing used are edge detection, filling, morphological operation and others. The image of egg parasite will be expected to appear without other subjects inside result image. This project will give benefit to biomedical industry and human health as it acts as a specialist to acknowledge a patient's condition by the existence of types of parasite living in one's body.

## ABSTRAK

Projek ini mengkaji tentang pembangunan pengesanan telur parasit manusia menggunakan imej mikroskop secara automatik. Program MATLAB merupakan alat untuk menganalisis teknik pemprosesan imej yang digunakan dalam kajian ini. Peringkat-peringkat teknik pemprosesan imej ialah pengambilan imej, pemprosesan, penyusunan mengikut kelas dan pengujian. Input imej merupakan sebuah imej mikroskop dengan tiga nilai resolusi yang berbeza. Parasit digunakan dalam eksperimen ditemui di sampel 'faecal' yang disediakan oleh doktor di HUSM. Projek ini mengkategorikan dua jenis cacing parasit iaitu Roundworm, *Ascaris Lumbricoides* dan Whipworm, *Trichuris Trichiura*. Identifikasi parasit adalah berdasarkan sifat bulat, bentuk dan kejelasan. Program MATLAB mengenalpasti jenis parasit berdasarkan kasifikasi yang dibuat sebelumnya. Pemprosesan imej menggunakan pengesan bucu, pemenuhan, operasi morfologi dan lain-lain. Telur parasit dijangka untuk muncul dengan sebarang subjek lain dalam imej terakhir. Projek ini akan member faedah kepada industri biomedik dan kesihatan manusia kerana ia bertindak sebagai pakar untuk mengetahui keadaan pesakit dengan kewujudan jenis parasit yang terdapat dalam tubuh seseorang.

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**LIST OF SYMBOLS/ABBREVIATIONS/NOTATIONS/TERMINOLOGY**

n	-	nano
m	-	meter
$\pi$	-	pi = 3.14159

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# Chapter 1

## INTRODUCTION

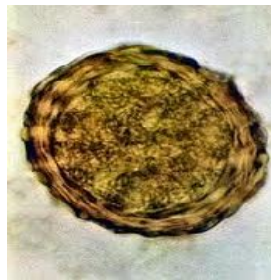
### 1.1 Project Background

– The intestinal parasites are common infections world-wide and cause many illnesses such as irritation, damaged tissue, parasitic contamination, microorganism intrusion, allergic response by the human body itself. The intestinal parasites are parasites that populate the gastro-intestinal tract in humans and other animals. The parasites in the intestines can be classified into two classes. These are Protozoa and Helminthes. The Helminthes are separated many categories such as Fasciola, Schistosoma, Ascaris, Hookworm, Trichuris, Taenia and Enterobius. *Ascaris lumbricoides* is a parasitic nematode (roundworm). *A. lumbricoides* invades the gastrointestinal tract after consumption of its eggs in contaminated food or drink or from fomites. *A. lumbricoides* migrates from the intestines to the lungs via the bloodstream. It is then swallowed and returned to the small intestine, where it reproduces. A high parasite load can cause nutritional deficiencies, especially in those consuming marginal diets.

*Trichuris trichiura*, the Whipworm, causes infestation after consumption of egg contaminating foodstuffs. It reproduces in the intestinal tract and the eggs are found in the feces. Heavy parasite loads may result in dysentery in the host.



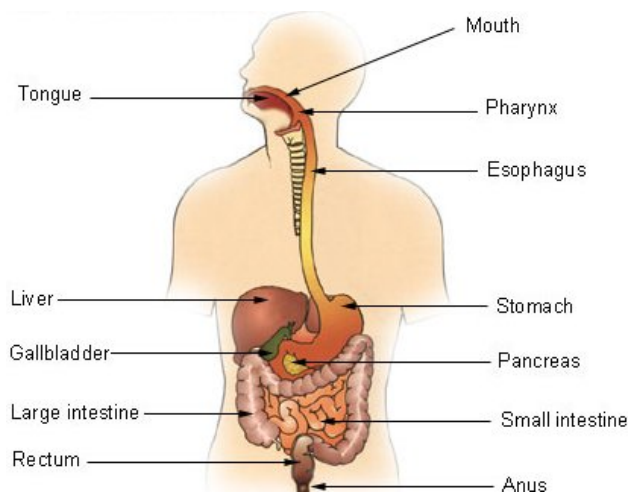
**Figure 1.1:** Infected digestive system



**Figure 1.2:** Roundworm, *Ascaris Lumbricoides*



**Figure 1.3:** Whipworm, *Trichuris Trichiura*



**Figure 1.4:** Gastro-intestinal tract in human

In general, identification and detection are direct methods primarily developed to define presence or absence, and to discriminate among parasite groups. Diagnostic techniques, on the other hand, can be either direct or indirect in nature and tend to define the disease state of an individual or animal. In some cases identification, detection and diagnosis are mutually exclusive.

Diagnosis is most often made by detection of the eggs in a faecal specimen. However, whole specimens may be obtained from the mouth or nares after the worms have migrated to these sites. Whole specimens have also been obtained surgically from the intestines. The cysts and eggs of endoparasites, which cause infection inside human body may be found in feces which aids in the detection of the parasite in the human host while also providing a means for the parasitic species to exit the current host and enter other hosts. The human body exposed to parasites by food, and water sources, soil, vegetables, fruits, animals and others.

Microscopy plays a prominent role in the identification of microorganisms, and in all likelihood, will continue to do so in the foreseeable future. Microscopic image processing is the digital image processing technique to process, analyze and present images obtained from a microscope. A number of manufacturers of microscope now specifically design in features that allow the microscopes to interface to an image processing system. Image processing for microscopy application begins with fundamental techniques intended to most accurately reproduce the information contained in the microscopic sample. This might include adjusting the brightness and contrast of the image, averaging images to reduce image noise and correcting for illumination non-uniformities.



**Figure 1.5:** Three figures of microscopic images

The current practice of diagnose parasite rely to human services of medical team such as doctor and physician. To treat human for parasites, the doctor must diagnose the specific parasite. He will perform tests based on human symptoms. The diagnosis will be done step by step by firstly, produce a stool specimen in a clean, dry container. Then, a blood sample is allowed to be taken to check for parasites that can be found in human blood. After that, a blood sample is allowed for serum/plasma to have immunodiagnostic tests performed. If no detection, he will submit to other types of specimen samples such as tissues, sputum, a vaginal swab or urine as requested by physician. Lastly, the physician is allowed to do an endoscopy, an X-ray, an MRI scan or a CT scan if other diagnostic procedures are not conclusive. There are huge samples to diagnose in specimen sample testing and less efficiency of the eggs detection result.

Generally, the larger the volume of the sample, the greater the chances for parasite detection following concentration; however, processing large volumes can be labor-intensive, time-consuming, costly, and can result in increased levels of contaminants which may interfere with subsequent detection methods. Whenever possible, faecal samples should be obtained directly from the animal to minimize the risk of cross-contamination, and prevent the introduction of parasites by insects. Thus, feces collected from the ground should be discarded if there is obvious evidence of insect activity. Ideally faecal samples should be processed within a few hours of collection or stored cold to prevent loss of moisture, overgrowth by fungi, and deterioration of antigen or DNA.

In this project, the automatic detection using techniques of image processing is proposed to detect the characteristics of parasite eggs. It has three stages that are image acquisition, processing stage, feature extraction stage, classification stage, and testing stage. In pre-processing stage, the digital image processing methods, which are noise reduction, contrast enhancement, thresholding, and morphological and logical processes. The process is continued with feature extraction and classification stage. The data will be tested using MATLAB software.

## **1.2 Project Objective**

This project proposed a development of an automatic detection system to detect type of parasite in faecal sample using image processing technique. The techniques used in this project recognize the characteristics of eggs based on shape, smoothness and roundness.

## **1.3 Scopes Of Project**

- i. Detection of eggs of two common human parasite worm, Roundworm (*Ascaris Lumbricoides*) and whipworm (*Trichuris Trichiura*)
- ii. Detection in microscopic image
- iii. Using image processing techniques
- iv. MATLAB software application



## 1.4 Problem Statement

- Diagnose of parasite is rely to human whereby microscope is used to detect parasite in a faecal sample. Due to huge sample of faecal to diagnose, technologies tend to make wrong result of detection. Otherwise, it is easier using microscopic image because it can be save inside computer's memory. Human fault is also a problem that cannot be prevented. Sometimes the doctor forgot about the characteristics of eggs of parasite and mistreated patient. Using software system, the source code is not easily change and the system will remembered the characteristics of egg of parasite to be determined. According to Hospital Universiti Sains Malaysia (HUSM), they received more than 100 sample of parasite per day. Generally, the larger the volume of the sample, the greater the chances for parasite detection following concentration; however, processing large volumes can be labor-intensive, time-consuming, costly, and can result in increased levels of contaminants which may interfere with subsequent detection methods.

## **Chapter 2**

### **LITERATURE REVIEW**

#### **2.1 Literature review**

– Dogantekin (2007) study proposed a robust technique based on invariant moments – adaptive network based fuzzy inference system (IM-ANFIS). In this technique, some digital image processing methods such as noise reduction, contrast enhancement, segmentation, and morphological process are used for feature extraction stage of IM-ANFIS approach used in this study.

In order to automate routine fecal examination for parasitic diseases, Yang (2001) paper propose in this study a computer processing algorithm using digital image processing techniques and an artificial neural network (ANN) classifier. The morphometric characteristics of eggs of human parasites in fecal specimens were extracted from microscopic images through digital image processing. An ANN then identified the parasite species based on those characteristics. He selected four morphometric features based on three morphological characteristics representing shape, shell smoothness, and size.

In Avci and Varol (2007) paper, it is proposed a new methodology based on invariant moments and multi-class support vector machine (MCSVM) for classification of human parasite eggs in microscopic images. The MCSVM is one of the most used classifiers but it has not used for classification of human parasite eggs to date. This method composes four stages. These are pre-processing stage, feature extraction stage, classification stage, and testing stage. In pre-processing stage, the digital image processing methods, which are noise reduction, contrast enhancement, thresholding, and morphological and logical processes. In feature extraction stage, the invariant moments of pre-processed parasite images are calculated. Finally, in classification stage, the multi-class support vector machine (MCSVM) classifier is used for classification of features extracted feature extraction stage. We used MATLAB software for estimating the success classification rate of proposed approach in this study. For this aim, proposed approach was tested by using test data. At end of test, 97.70% overall success rates were obtained.

Image segmentation remains one of the major challenges in image analysis, since image analysis tasks are often constrained by how well previous segmentation is accomplished. In particular, many existing image segmentation algorithms fail to provide satisfactory results when the boundaries of the desired objects are not clearly defined by the image intensity information. In medical applications, skilled operators are usually employed to extract the desired regions that may be anatomically separate but statistically indistinguishable. Such manual processing is subject to operator errors and biases, is extremely time consuming, and has poor reproducibility. Chen *et al.* (1998) propose a robust algorithm for the segmentation of three-dimensional (3-D) image data based on a novel combination of adaptiveK-mean clustering and knowledge based morphological operations. The proposed adaptive K-mean clustering algorithm is capable of segmenting the regions of smoothly varying intensity distributions. Spatial constraints are incorporated in the clustering algorithm through the modeling of the regions by Gibbs random fields. Knowledge-based morphological operations are then applied to the segmented regions to identify the desired regions according to the a priori anatomical knowledge of the region-of-interest. This proposed technique has been successfully applied to a sequence of cardiac CT volumetric images to generate the volumes of

left ventricle chambers at 16 consecutive temporal frames. Their final segmentation results compare favorably with the results obtained using manual outlining. Extensions of this approach to other applications can be readily made when a priori knowledge of a given object is available.

Martin *et al.* (2010) present an example-based approach to synthesizing stipple illustrations for static 2D images that produces scale-dependent results appropriate for an intended spatial output size and resolution. They show how treating stippling as a grayscale process allows them to both produce on-screen output and to achieve stipple merging at medium tonal ranges. At the same time they can also produce images with high spatial and low color resolution for print reproduction. In addition, they discuss how to incorporate high-level illustration considerations into the stippling process based on discussions with and observations of a stipple artist. Also, certain features such as edges can be extracted and used to control the placement of dots to improve the result. The implementation of the technique is based on a fast method for distributing dots using halftoning and can be used to create stipple images interactively. They describe both a GPU implementation of the basic algorithm that creates stipple images in real-time for large images and an extended CPU method that allows a finer control of the output at interactive rates.

Advances in visualization technology and specialized graphic workstations allow clinicians to virtually interact with anatomical structures contained within sampled medical-image datasets. A hindrance to the effective use of this technology is the difficult problem of image segmentation. In Shareef *et al.*(1999) paper, they utilize a recently proposed oscillator network called the locally excitatory globally inhibitory oscillator network (LEGION) whose ability to achieve fast synchrony with local excitation and desynchrony with global inhibition makes it an effective computational framework for grouping similar features and segregating dissimilar ones in an image. They extract an algorithm from LEGION dynamics and propose an adaptive scheme for grouping. They show results of the algorithm to two-dimensional (2-D) and three-dimensional (3-D) (volume) computerized topography

(CT) and magnetic resonance imaging (MRI) medical-image datasets. In addition, they compare their algorithm with other algorithms for medical-image segmentation, as well as with manual segmentation. LEGION's computational and architectural properties make it a promising approach for real-time medical-image segmentation.

Multiscale image analysis has been used successfully in a number of applications to classify image features according to their relative scales. As a consequence, much has been learned about the scale-space behavior of intensity extrema, edges, intensity ridges, and grey-level blobs. In Gauch (1999) paper, they investigate the multiscale behavior of gradient watershed regions. These regions are defined in terms of the gradient properties of the gradient magnitude of the original image. Boundaries of gradient watershed regions correspond to the edges of objects in an image. Multiscale analysis of intensity minima in the gradient magnitude image provides a mechanism for imposing a scale-based hierarchy on the watersheds associated with these minima. This hierarchy can be used to label watershed boundaries according to their scale. This provides valuable insight into the multiscale properties of edges in an image without following these curves through scale-space. In addition, the gradient watershed region hierarchy can be used for automatic or interactive image segmentation. By selecting subtrees of the region hierarchy, visually sensible objects in an image can be easily constructed.

## **Chapter 3**

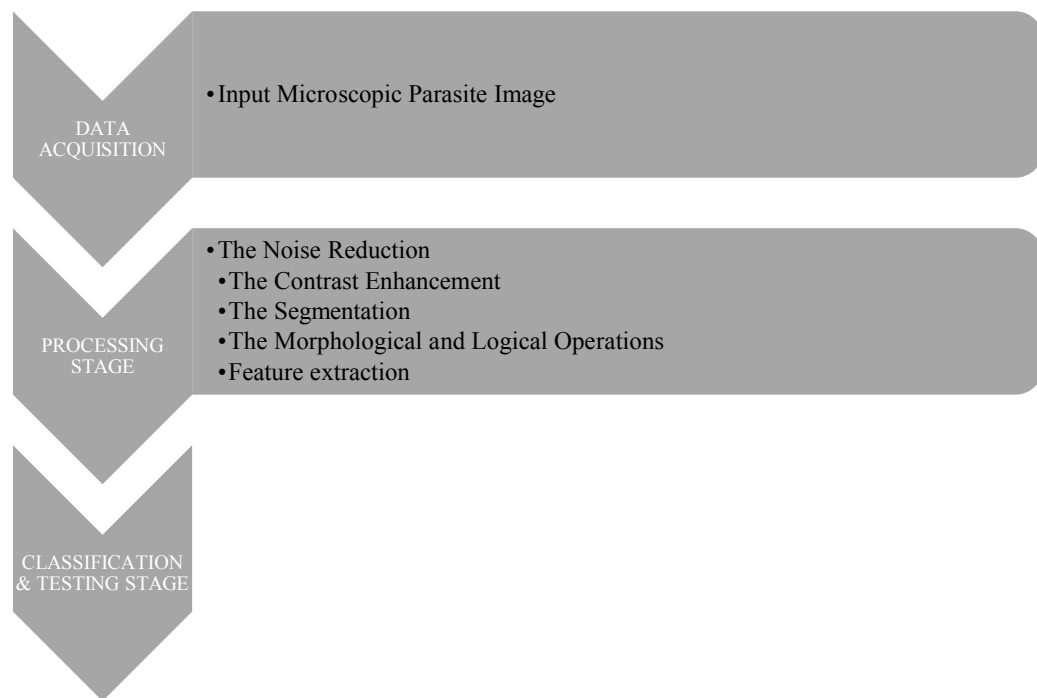
### **METHODOLOGY**

#### **3.1 Introduction**

This chapter explains all of methodology for this project. It describes on how these project is organized which is the flow of step in order to complete the project.

### 3.2 System flow

The system flow of image processing technique is shown in Figure 3.1.



**Figure 3.1:** Processing stage

### 3.2.1 Eggs of Parasite Data Information

The image data of two types of parasites are collected by using microscope available at HUSM located at Kubang Kerian, Kelantan.. The sample of the parasites which comes from the faecal is provided by the doctor at HUSM.



**Figure 3.2:** HUSM at Kubang Kerian

The microscope used has three different resolutions which is high resolution value that reduced noise in image acquired. Figure 3.2 shows the two images of two types of parasite worms. We can see the difference between both eggs.